RoboCup2005
Rescue Robot League Competition
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RoboCupRescue - Robot League Team rescNUbots (Australia)

Rick Middleton, Stephan Chalup, Robert King, Joshua Marshall [1]

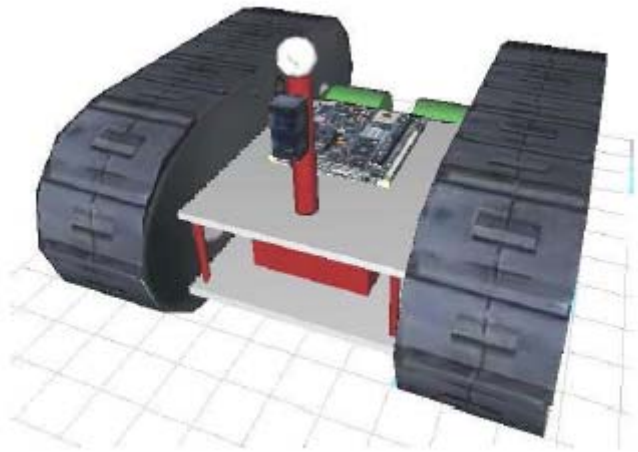
[1] University of Newcastle Robotics Laboratory
C/- School of Electrical Engineering and Computer Science
The University of Newcastle, 2308, Australia
http://www.robots.newcastle.edu.au/
{Rick.Middleton,Stephan.Chalup, Robert.King}@newcastle.edu.au

Abstract. Building on the success of the NUbots Robocup Soccer team, a new team for rescue robotics has been formed. Robot hardware based around a tracked vehicle with independent continuously variable control, and a number of sensors has been constructed. The user will interface to a laptop computer and use standard wireless 802.11g (or possibly a) communications with the robot. An extended Kalman filter will be developed for simultaneous map building and localisation incorporating information from rotation, electronic compass, scanning laser and vision sensors.

Introduction

The Newcastle Robotics Laboratory combines researchers from Computer Science, Electrical Engineering and Statistics with a focus on applications to Robocup. The laboratory brings together research from a range of fields including Machine Learning, Automatic Control, Statistical Signal Processing, etc. to achieve practical outcomes. The Newcastle robotics laboratory has been supported by a variety of sponsors including the University of Newcastle, local businesses, and the Australian Research Council Centre for Complex Dynamic Systems and Control.

From this group, the ‘NUbots’ have successfully competed for three years in the Robocup Soccer Sony 4 Legged League, coming 3rd in the competition for 2002-2004 inclusive. During 2004, a final year student project was conducted by Joshua Marshall to develop the hardware for a rescue robot. This project demonstrated a working rescue robot in November 2004. We have therefore taken the step to submit a team entry to the 2005 Robocup competition for the “rescNUbots” based on this hardware.



rescNUbot Schematic (from [1])

1. Team Members and Their Contributions

- Team Leader: Rick Middleton
- Operator: Josh Marshall
- Mechanical design: Josh Marshall
- Controller development: Jason Kulk

2. Operator Station Set-up and Break-Down (10 minutes)

The operator station uses a standard Laptop communicating via IEEE802.11g/a with the robot. (Note that the robot hardware supports a or g communications, but the laptop supports only g; we have not been able to source as yet a wireless hub that supports a: provided one is available, or can be sourced, we will be able to use 802.11a).

Map printing will require connection to a printer.

3. Communications

rescNUbots (Australia)		
MODIFY TABLE TO NOTE ALL FREQENCIES THAT APPLY TO YOUR TEAM		
Frequency	**Channel/Band**	**Power (mW)**
5.0 GHz - 802.11a		
2.4 GHz - 802.11b/g		

As noted above, robot hardware supports a or g communications, but we do need to find a wireless hub to be able to use 'a'.

4. Control Method and Human-Robot Interface

Our current proposal for the 2005 Competition is to use the robot in essentially a remote control mode. However, we are planning to incorporate some basic higher level commands such as:

- 'stop' (cease motion)
- 'look' (rotate, and find areas open to movement)
- 'continue' (keep moving forward until either obstructed, or object of interest find)
- 'return to checkpoint' (return to designated checkpoint on the map)

5. Map generation/printing

Our proposal for map building would be automatically generated from vision, odometry, scanning laser and electronic compass data, together with operator annotations.

6. Sensors for Navigation and Localization

The team has extensive experience in the use of the extended Kalman filter and other statistically based tools for combining sensor data. Motor encoders will be used to infer the predicted motion. However, clearly these will be inaccurate over longer time frames, and sensor data (including an electronic compass, vision, scanning laser range finder) will also be used. From the vision and scanning laser data, we will be attempting to extract 'corner' features that will be built onto an automatically generated map. As the robot moves, these features can then be used as landmarks for localisation purposes.

7. Sensors for Victim Identification

Our plan is to incorporate Thermal, Visual, Scan, Audio and CO2 sensors. We have Visual and Scan sensors built and working, and aim also to add thermal and CO2. Audio is available via the webcam used for vision. This will need to be tested.

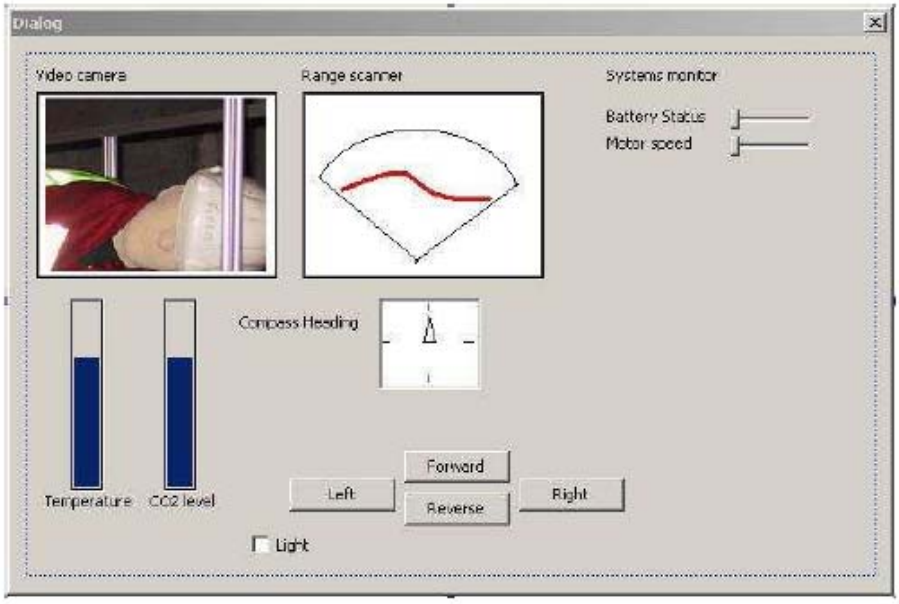
8. Robot Locomotion

Tracked, dual regenerative switchmode converters, independent continuously variable track speed.

9. Other Mechanisms

10. Team Training for Operation (Human Factors)

Our current user interface uses a GUI on the laptop, and should require little operator training. A simplified form of the interface [1] is shown below:



11. Possibility for Practical Application to Real Disaster Site

Designed battery life is at least 1hr. Mechanism is quite rugged, possibly slightly ocersize. We have not checked communications range for application to a real disaster sight.

12. System Cost

TOTAL SYSTEM COST (approximate, parts only, per robot): US$1,200

KEY PART NAME: Tracks
PART NUMBER:
MANUFACTURER: Sno-trac ?
COST: US$180 (no longer available)
WEBSITE: http://www.robotcombat.com/marketplace_treads.html
DESCRIPTION/TIPS:
The tracks provide structural support for the robot chassis, along with the drive mechanism. The motors are mounted inside the tracks. Requires high torque to drive successfully.

KEY PART NAME: Processor & Motherboard
PART NUMBER: EPIA M10000
MANUFACTURER: VIA
COST: US$160
WEBSITE: http://www.mini-box.com/s.nl/sc.8/category.15/it.A/id.230/.f
DESCRIPTION/TIPS:
Low power 1 Ghz x86 processor and motherboard. Provides multiple I/O methods.

KEY PART NAME: Camera
PART NUMBER: QuickCam Pro 4000
MANUFACTURER: Logitech
COST: US$115
WEBSITE:
http://www.auspcmarket.com.au/show_product_info.php?input[product_code]=DC-LOQCPRO4000&input[category_id]=1134
DESCRIPTION/TIPS:
Camera with resolution of 640x480. Gain and white balance is software adjustable.

KEY PART NAME: Scanning Range Finder
PART NUMBER: PB911
MANUFACTURER: Hokuyo
COST: US$500

WEBSITE: http://www.hokuyo-aut.jp/products/o_detect/o_detect.htm
DESCRIPTION/TIPS:

KEY PART NAME: Other Electronics
PART NUMBER: various
MANUFACTURER: various
COST: approx US$250
WEBSITE:
DESCRIPTION/TIPS:

References

1. Marshall, J., “Robocup Rescue Robot”, 2004 Final Year Electrical Engineering Undergraduate, Project, School of Electrical Engineering and Computer Science, The University of Newcastle, 2308, Australia http://murray.newcastle.edu.au/users/students/2004/c2007000/index.html, (2004)